



Living Standards
Measurement Study
Working Paper No. 37

Health Care Financing and the Demand for Medical Care

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Avi Dor
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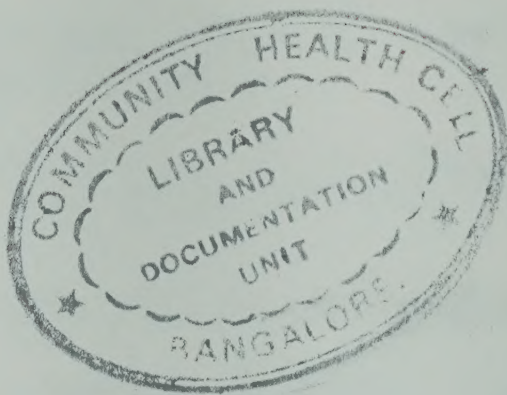
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RS-130
04760



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May 1987

LIVING STANDARDS MEASUREMENT STUDY

The Living Standards Measurement Study (LSMS) was established by the World Bank in 1980 to explore ways of improving the type and quality of household data collected by Third World statistical offices. Its goal is to foster increased use of household data as a basis for policy decision making. Specifically, the LSMS is working to develop new methods to monitor progress in raising levels of living, to identify the consequences for households of past and proposed government policies, and to improve communications between survey statisticians, analysts, and policy makers.

The LSMS Working Paper series was started to disseminate intermediate products from the LSMS. Publications in the series include critical surveys covering different aspects of the LSMS data collection program and reports on improved methodologies for using Living Standards Survey (LSS) data. More recent publications recommend specific survey, questionnaire and data processing designs, and demonstrate the breadth of policy analysis that can be carried out using LSS data.

ABSTRACT

This LSMS working paper includes two reports that are part of a larger study on "Health Care Demand and Resource Mobilization".^{1/} This study addresses the issue of how various financing systems for medical care influence its utilization. Emphasis is on the impact of introducing (or raising) user fees, in terms of distributional effects, welfare consequences and revenue potential.

The first paper develops a discrete choice model that allows for the quantification of the effects of price and non-price variables on a person's decision of whether or not to obtain medical care, and if so, from which provider. The empirical work is based on recent data from a Peruvian health survey. The second paper estimates a variant of this model, using data from the 1985 Ivorian Living Standards Survey.

The major message of both papers is that in the absence of user fees (or at low fee levels) private costs (here represented by travel time to the nearest provider) take over the rationing role of the conventional price mechanism. The first paper shows how the quantification of this effect can be used to simulate the distributional and welfare consequences of changing the fee structure.

None of the results in these papers should be judged as final, if only because both papers focus on provider choice rather than on total medical consumption. However, the main empirical results appear to be robust, and the effect of non-price rationing is found to be much stronger than previously reported in the literature.

^{1/} Each report is self-contained which results in a certain amount of overlap in the exposition.

ACKNOWLEDGMENT

We like to thank staff and consultants of the Living Standards Unit for their many useful comments and stimulating discussions of the various previous drafts of these reports. The second paper in this publication benefitted from excellent research assistance provided by Hailu Mekonnen. All of us are indebted to Ann van Aken, Carmen Martinez and Brenda H. Rosa for skillful word processing.

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I. Are User Fees Regressive?

The Welfare implications of Health Care Financing Proposals in Peru

I. INTRODUCTION

Many developing countries have created extensive publicly supported health care systems, access to which is at little or no cost. ^{1/} The financial crisis of the 1980s has forced many of them to consider instituting user fees (i.e. charge individuals for access). Those in favor of user fees argue that they facilitate recovery of the cost of providing the service, and, if they are set at marginal cost, improve allocative efficiency. ^{2/} The strongest argument against user fees is that they may be regressive in that they may not allow all income groups equal access to medical care because the poor may be more price sensitive than the rich. Even if everyone is equally price sensitive, user fees will be regressive if the welfare loss for the poor relative to income is larger than for the rich.

In the absence of user fees, equal access is still not assured. It has been well known since Acton (1975) that nonmonetary access costs such as travel time are important determinants of health care choices. The geographical distribution of services may make access more difficult for some groups. For example, locating facilities closer to the upper and middle classes discriminates against the poor. User fee proponents argue that revenues can be reinvested to reduce nonmonetary access costs, and consequently minimize consumers' welfare loss.

Since user fee proposals are so widespread and the potential welfare effects so large, it is important that some ex ante analysis be performed. This paper provides a methodology for such an ex ante analysis, and to our knowledge, the first estimates of expected revenues and welfare losses (measured as compensating variations) associated with one such proposal.

The analysis requires estimation of the demand for health care, from which the revenues and welfare changes of proposed user fees can be simulated. The magnitude of the revenue and welfare effects depend crucially on the price elasticity of demand. Previous studies in developing countries have found little if any impact of price on demand. These studies model the demand for health care as a discrete choice between alternative providers, with the price effect specified to be independent of income.^{3/} This assumption is extremely restrictive, since one would expect the wealthy to be less sensitive to price differences across providers than the poor. Indeed, we show that this specification is inconsistent with stable utility maximization, and that, if health is a normal good, the demand for health care must become more price elastic as income falls.

The discrete choice specification in this paper is derived from a theoretical model that implies a natural interaction between price and income in the demand functions, and those demand functions are estimated using a parsimonious flexible functional form that allows the data to determine the effect of income on price elasticities. The resulting model facilitates the study of the distributional impacts of user fees.

The empirical investigation considers the potential effects of user fees in urban Peru. The estimates show that price plays an important role in health care demand. Further, demand becomes more elastic as income falls indicating, as expected, that health is indeed a normal good. This implies that the introduction of health care user fees in Peru would reduce access proportionally more for the poor than the rich, and, in this sense, be regressive. Our simulations demonstrate that while user fees would generate substantial revenues, they would also generate substantial reductions in

aggregate consumer welfare with the burden of the loss on the poor. The simulations also indicate that the welfare loss from the current spatial distribution of public health care services is roughly equal to the expected welfare loss from moderate user fees, and that the loss is fairly evenly distributed across income groups. Therefore, if the government imposed moderate user fees and used the revenues to solve the rationing problem, there would be little if any aggregate welfare loss, but there would be a redistribution of welfare from poor to rich.

II. BEHAVIORAL ASSUMPTIONS

The framework for this discussion is a static model in which utility depends on health and consumption of goods other than medical care. When an illness or accident is experienced, individuals must decide whether to seek medical care. The benefit from consuming medical care is an improvement in health, and the cost of medical care is a reduction in the consumption of other goods. Individuals not only have to decide whether to seek care, but also what type of care. They are faced with a set of alternative providers, each of which has a different potential impact (efficacy) on their health. This efficacy depends on providers' skills, individuals' characteristics (e.g. medical problems, general health status, and ability to implement the recommended treatment plan), and a random term that captures the notion that the efficacy of medical care is not deterministic. An individual's expectation of this impact can be viewed as the perceived quality of care.

In essence, individuals are faced with a discrete choice decision. A choice must be made between the various provider alternatives, including self-care. Each alternative offers a set package (quality) for a given price,

where the price includes both monetary outlays and nonmonetary access costs such as travel and waiting time. Based on this information, their health statuses, types of medical problems, and incomes, individuals choose the alternatives that yield the greatest utilities.

We consider the short run utility maximization problem faced by an individual who has recently experienced an accident or illness. Let the utility, conditional on receiving care from provider j , be given by

$$U_j = U(H_j, C_j, T_j) \quad , \quad (1)$$

where H_j is expected health status after receiving treatment from provider j , C_j is expenditures on consumption after paying provider j , and T_j is the nonmonetary cost of access to provider j .

The health care purchased from provider j is invested in health. The perceived quality (marginal product) of provider j 's medical care is the expected improvement in health. Let H_0 be expected health status without professional medical care (i.e. self-treatment); then, the perceived quality of provider j 's care is $Q_j = H_j/H_0$, which yields an expected health care production function of the form

$$H_j = Q_j H_0 \quad , \quad (2)$$

where H_j is proportional to H_0 . The quality parameter depends upon provider characteristics (e.g. training and facilities) and individual characteristics (e.g. type and severity of illness).

This production function takes on a rather simple form for the self-care alternative. Since H_j equals H_0 , the proportionality factor is unity for the self-care alternative. In effect, this normalizes the health care production function so that the quality of a particular provider's care is measured relative to efficacy of self-care.

The level of consumption expenditure conditional on choosing provider j , C_j , is derived from the budget constraint. Let P_j be provider j 's price and Y be income, then

$$C_j = Y - P_j, \quad (3)$$

with $C_j \geq 0$ required for feasibility. ^{4/} Substitution of (3) into (1) yields

$$U_j = U(H_j, Y - P_j, T_j) .$$

Income affects utility through the consumption term, and is assumed to be exogenous. ^{5/}

Now we are ready to specify the utility maximization problem. Suppose the individual has $J+1$ feasible alternatives (with the $j=0$ alternative being self-care). The unconditional utility maximization problem is

$$U^* = \max(U_0, U_1, \dots, U_J) , \quad (4)$$

where U^* is the highest utility the individual can attain.

If health is a normal good, then the demand for health increases with income. A necessary condition for normality is that as income rises, the

marginal rate of substitution of consumption for health diminishes, holding health constant. This point is demonstrated in figure 1, where the continuous choice case with health being a normal good is pictured. As income rises the point of utility maximization moves out from the origin along the expansion path. Holding health constant at A, we move to the right along the horizontal line as income rises, intersecting the indifference curves at points of flatter slopes, implying a diminishing marginal rate of substitution.

In a discrete choice world, normality implies that as income rises individuals are more likely to choose the "higher price/higher quality" options. Here as well, a necessary condition for normality is that as income rises, the marginal rate of substitution of consumption for health diminishes, holding health constant. This is demonstrated in figure 2, where the discrete choice case with health as a normal good is pictured. In figure 2, there is a choice between a "high price/high quality" option (P_h, Q_h), and a "low price/low quality" option (P_ℓ, Q_ℓ). At a low income level, say Y_ℓ , the choice is between points A and B; i.e. between a gain in health of $(H_h - H_\ell)$ and a gain in consumption of $(P_h - P_\ell)$. At income Y_ℓ , the additional consumption is preferred to the additional health and the "low price/low quality" option B is chosen. The high income individual with income Y_h has a choice between points C and D. These points represent the same tradeoff between health and consumption as points A and B. As income rises the marginal rate of substitution of consumption for health falls along both horizontal lines H_h and H_ℓ . Eventually, at some income between Y_ℓ and Y_h , the gain in health is preferred to the gain in consumption. At income Y_h , the "high price/high quality" option C is chosen.

In a discrete choice world, if health is a normal good, a rise in income increases the likelihood that individuals purchase "higher price/higher quality" alternatives. Another way of looking at this is that an increase in price is less likely to dissuade richer individuals from choosing the "higher price/higher quality" alternatives. In a probabilistic sense, normality implies that richer individuals are less price elastic than poorer individuals.

III. EMPIRICAL SPECIFICATION

The solution to (4) yields a system of demand functions, whose forms are probabilities that the alternatives are chosen given that an individual experiences an accident or illness. The demand function for a given alternative is found by calculating the probability that this particular alternative yields the highest utility amongst all the alternatives. The functional form of the demand functions depends on the functional form of the utility function conditional upon choosing a particular provider and the distribution of the stochastic variables.

A. The Conditional Utility Function

It is customary to begin by considering a linear functional form for the conditional utility function in (1). Substitution of (3) into a linear utility function yields

$$U_j = \alpha_1 H_j + \alpha_2 (Y - P_j) + \alpha_3 T_j + \epsilon_j \quad (5)$$

where ϵ_j is a random taste shock that is uncorrelated across alternatives. Notice that $\alpha_2 Y$ enters each alternative's utility function, implying that the influence of income on utility does not vary by alternative. Since only differences in utility matter, a linear utility function imposes the restriction that income has no effect on the choice of provider and that the marginal rate of substitution is constant. Therefore, this specification is inconsistent with health being a normal good.

A common method of trying to relax this restriction is to allow the coefficient on consumption to vary by alternative. ^{6/} That specification violates the maximization of a stable utility function. It asserts that, holding income, prices, and health constant, the marginal rate of substitution varies by alternative.

A parsimonious parameterization that does not place second order restrictions on the marginal rate of substitution, does not violate the maximization of a stable utility function, and is linear in parameters, is the semi-translog, where health and access costs enter in log form and consumption enters in both log and log squared form. ^{7/} Substitution of (2) and (3) into a semi-translog conditional utility function yields

$$U_j = \ln H_0 + \ln Q_j + \alpha_1 \ln(Y - P_j) + \alpha_2 \ln(Y - P_j) \ln(Y - P_j) + \alpha_3 \ln T_j + \epsilon_j \quad (6)$$

The quadratic term is necessary so that the specification does not impose normality and a diminishing marginal rate of substitution, but rather allows us to test for them.

B. Quality

In equation (6) neither $\ln H_0$ nor $\ln Q_j$ are observed. Since $\ln H_0$ appears in the utility function for all the choices and its value does not vary by alternative, it does not influence which alternative is preferred, and therefore can be ignored.

A more difficult issue arises because of the unobservability of $\ln Q_j$. To solve this problem we specify a quality (marginal product) function for each provider type. Specifically, let the expected quality from provider j be

$$\ln Q_j = \beta_{0j} + \beta_{1j}X + \beta_{2j}Z_j + \tau_j, \quad (7)$$

where X is a vector of the individual's characteristics (i.e. measures of health status, severity of illness and education), Z_j is a vector of characteristics of provider j , and τ_j is a random shock. The error term τ_j represents unobserved individual characteristics, such as severity and complexity of illness, that may affect the providers' marginal productivities relative to self-care. Recall that quality is normalized relative to the self-care alternative, implying that $\ln Q_0 = 0$. The error term τ_j may be correlated across the non-self-care alternatives.

The reduced form conditional utility function for alternative j is found by substituting (7) into (6). Specifically, for alternatives $j=1, \dots, J$,

$$U_j = V_j + \epsilon_j + \tau_j, \quad (8)$$

where

$$V_j = \beta_{0j} + \beta_{1j}X + \beta_{2j}Z_j + \alpha_1 \ln(Y - P_j) + \alpha_2 \ln(Y - P_j) \ln(Y - P_j) + \alpha_3 \ln T_j.$$

Note that the intercept and coefficients on the quality terms vary by alternative as do the values of consumption and access costs (but not their coefficients). Since $\ln Q_0 = 0$, $T_0 = 0$, and $P_0 = 0$, the reduced form conditional utility function for the self-care alternative becomes

$$U_0 = \alpha_1 \ln Y + \alpha_2 \ln Y \ln Y + \epsilon_0.$$

Note further that τ_0 does not exist as quality is normalized relative to the self-care alternative.

C. The Budget Constraint

Specification of the budget constraint requires determining the relevant budgeting period. Since the health care decision is discrete and made irregularly, consumers may be willing to borrow against future income. If capital markets are perfect and individuals (or families) can borrow without restriction, the relevant income constraint is the present value of income, or wealth. The other extreme assumption is that no resources outside each income period can be used. The actual period may be somewhere in between.

We let the data determine the appropriate budgeting period. Define y as permanent monthly income and r as the period discount rate, then the constraining income in (4) is ky , where the parameter k is a function of the

length of the budgeting period and r . If budgeting is restricted to one period, then k is equal to 1. If the budgeting period is infinity (i.e. there is perfect borrowing and lending), then k is equal to $1/r$.

The addition of k implies (8) is no longer linear in parameters. We linearize (8) using an approximation to the log of consumption. The log of consumption can be expressed as

$$\ln(ky - P_j) = \ln(1 - P_j/ky). \quad (9)$$

Since P_j/ky , the budget share of alternative j , is expected to be small, the second term in (9) can be approximated by $-P_j/ky$, which allows us to rewrite the log consumption and log consumption squared terms in (8) as

$$\alpha_1 \ln(ky) + \alpha_2 \ln(ky) \ln(ky) - [(\alpha_1 + 2\alpha_2 \ln k)/k](P_j/y) + (\alpha_2/k^2)(P_j/y)^2 - (2\alpha_2/k)(P_j/y) \ln y. \quad (10)$$

Notice that the first two terms in (10) are the same across all alternatives, including self-care. Since only differences in utility across alternatives matter, these terms have no effect on provider choice, and therefore, can be left out. Further, when k equals one, (10) reduces to

$$-\alpha_1 (P_j/y) + \alpha_2 (P_j/y) (P_j/y - 2 \ln y). \quad (11)$$

Since both (10) and (11) are linear in parameters, they provide us with an easy likelihood ratio test for k equal to one.

D. The Demand Functions and Welfare

The demand function for an alternative is the probability that its utility is greater than from any other alternatives. McFadden (1981) shows that, given reasonable distributional assumptions on ϵ_j and τ_j , these demands take on a nested multinomial logit (NMNL) form, where it is first decided whether to seek care, and then conditional on seeking care deciding from which provider to seek care. The probability that provider j is chosen is

$$\Pi_j = \frac{\exp[\sigma \ln(\sum_{j=1}^J \exp(V_j))]}{\exp(V_0) + \exp[\sigma \ln(\sum_{j=1}^J \exp(V_j))]} \cdot \frac{\exp(V_j)}{(\sum_{j=1}^J \exp(V_j))}.$$

and the probability of self-care is

$$\Pi_0 = \frac{\exp(V_0)}{\exp(V_0) + \exp[\sigma \ln(\sum_{j=1}^J \exp(V_j))]}$$

where the V_j 's are given by (8) with (10) substituted for the log consumption terms. Also the $\alpha_1 \ln(ky)$ and $\alpha \ln(ky) \ln(ky)$ are excluded as they do not vary by alternative, which implies that $V_0 = 0$. The parameter σ is one minus the correlation of the $j=1, \dots, J$ utilities introduced by the τ_j 's.

McFadden also shows that NMNL reduces to a multinomial logit (MNL) when σ is unity. The NMNL is more general than MNL in that it allows correlation between the utilities that share common attributes, and therefore does not suffer from the independence of irrelevant alternatives assumption.

The estimated demand functions can be used to project the impact of user fees on demand (and revenues), and the number of people who do not seek

health care as a result of user fees. These demand functions also form the basis of our computation of the welfare costs of user fees, where the welfare costs are measured by compensating variations. ^{8/} For example, consider changing the vector of provider prices from P^1 to P^2 . Following Small and Rosen (1981), in the case of a nested multinomial logit, the amount of income the individual must be given to make him as well off at P^2 as at P^1 is

$$\Delta e = (1/\lambda) \{ \ln[\exp(V_0^1) + (\sum_{j=1}^J \exp(V_j^1))^\sigma] - \ln[\exp(V_0^2) + (\sum_{j=1}^J \exp(V_j^2))^\sigma] \} \quad (12)$$

where V_j^1 and V_j^2 are evaluated at P^1 and P^2 , respectively, and λ is the marginal utility of income. ^{9/} The compensating variation for nonprice changes (such as travel time) can be similarly calculated.

IV. DATA AND INSTITUTIONAL ENVIRONMENT

The empirical work utilizes data from a 1984 Peruvian household survey, the Encuesta Nacional de Nutricion y Salud (ENNSA). The survey contains a rich set of socio-economic data, as well as morbidity and health care utilization information for a two-week recall. Since this study analyzes contingent health care demand, we restricted our sample to those persons who reported having symptoms or an accident. The sample was taken from individuals living in the urban Sierra and Lima regions. Rural regions were excluded because reliable income data do not exist for them. A sample of 3412 individuals age 16 and above is the basis for this work. Descriptive statistics are presented in table 1.

Peru has a mix of public and private health care. The major provider of public health care is the Ministry of Health, which operates hospitals and clinics. The next largest provider of public health care is the Instituto Peruano de Seguridad Social (Social Security). It operates hospitals for its members, which are not available to non-members. In the analysis, Social Security hospitals are not viewed as a separate alternative, but rather are included in the public hospital alternative. A dummy variable indicating whether the individual was a Social Security member is included in the hospital equation to account for quality differences. The dominant private health care providers are physicians. Other types of private providers, such as traditional healers, and pharmacists were not numerically important, and were merged with the no consultation group to form our "self-care" alternative. The four alternatives are: (1) self-care; (2) public hospital; (3) public clinic; and (4) private doctor.

The arguments of the quality (marginal product) function are the initial state of health, the type of illness, human capital, and provider characteristics. Measures of health status prior to treatment are age and type of illness, which is measured by a set of dummy variables indicating whether the individual's medical problem was an accident or acute illness, digestive illness, respiratory illness, or other illness. The other illness dummy variable was excluded. The quality of providers is thought to vary by location. Hence, a set of regional dummy variables indicating if the individual lives in central Lima, the north and south cones of Lima, and the north, south, and central regions of the Sierra are included. The central Sierra dummy variable was excluded. In addition, the individual's education was included as a measure of human capital.

Income was measured as total family income in the month prior to the survey. Family income is the relevant concept here because family members are not provided or denied health care on the basis of their labor force statuses. This measure reduces the sensitivity of income to the illness of any particular family member.

Since income does not vary by alternative, we need variation in prices across alternatives to identify and estimate the coefficients on the log consumption and log consumption squared terms. In a discrete choice framework, identification requires variation across alternatives. Although variation across individuals is not necessary, it is desirable as it improves the estimation precision. In our data the public hospital and clinic prices do not vary by individual, but there is substantial cross-individual variation in private doctor prices as the data covers many different regions, were collected over a nine month period in which relative prices changed substantially.

Measuring prices posed a difficult problem. The model requires prices for each alternative, but these were not directly available. The ENNSA only collected price information for the provider from which the individual received care. For those who sought care, price data were only available for the alternative they chose, and for individuals who did not seek care there is no information.

The measurement problem was easily solved for hospitals and clinics, since they charged a user fee of 1,000 to 2,000 soles. In our sample, about 35 percent of hospital and clinic users reported paying nothing, about 50 percent reported paying 1,000 soles, and almost all the rest reported 2,000 soles. About half of the reported zero fees are from Social Security

hospitals, which do not charge their members for services. The other half are probably a result of failure to collect the fees. Since these prices are minuscule relative to monthly family income (see table 1), we assumed individuals expected to pay 1,000 soles at Ministry of Health hospitals and clinics.

For private doctor prices, we used the available information to estimate hedonic price equations, and then imputed prices for all individuals. The equation specified price to be a function of age, illness, and market structure variables such as population and availability of health care services. Income was not used in order to avoid attributing higher prices to higher income individuals who may have purchased higher quality care. An additional problem was selectivity bias. The observed distribution of prices paid will not be representative of the ex ante distribution of prices because individuals are more likely to choose low price alternatives. We corrected for this selectivity bias by following an instrumental variables procedure used in Dubin and McFadden (1984). ^{10/}

Finally, we measure nonmonetary access cost by travel time to the provider. The travel time data suffer from the same problems as the price data. In addition, travel time information was collected in discrete categories. Binary logit hedonic travel time equations (with selectivity bias correction) were used to estimate the probability of traveling more than an hour.

V. RESULTS

The parameters of a MNL and a NMNL were estimated by maximum likelihood. The NMNL nested the choice of provider within the choice of

whether to seek care at all. The hypothesis that the NMNL is not different from the MNL was accepted at the .05 level, and the hypothesis that k equals unity was also accepted at the .05 level. ^{11/} The estimated coefficients and associated t -statistics for the MNL with k equal to one are presented in table 2.

The coefficients on log consumption and log consumption squared are significant at the .1 and .01 levels, respectively. Price and income therefore play important roles in the demand for medical care. Since price and income enter in a highly nonlinear form it is difficult to assess their influence on demand just from looking at the coefficient values. For this reason, arc price elasticities for clinic, hospital and private doctor services were computed by sample income quintile and are presented in table 3. The price elasticities are negative over all prices and income groups, and demand is more elastic at lower incomes and at higher prices. The magnitude of the prices elasticities varies greatly by income. In the highest income quintile, demand appears to be completely inelastic, while demand in the lowest income quintile is much more sensitive to price.

We have assumed that income is exogenous. If, in fact, income is endogenous, there is a possibility of simultaneity bias. The bias is likely to have a downward impact on the estimated price and income effects, making them closer to zero. The effect we are interested in measuring is the causal impact of changes in income on health care demand. If health is a normal good, then that effect is positive. The simultaneity bias arises because an accident or illness may reduce income. The more severe and complex the illness or accident the greater the reduction in income. However, the more severely ill have greater medical need and are therefore more likely to seek

medical care. This implies that the observed relation between income and demand will likely be biased towards zero. Since price enters our model as a reduction in consumption ($Y - P$), its effect is also likely to be biased towards zero. Therefore, our estimated price elasticities should be lower bounds on the true elasticities.

The coefficient on the probability of traveling more than an hour is negative and estimated with precision. This implies that increases in nonmonetary access costs reduce demand.

The estimated quality parameters are consistent with our expectations. The coefficients on age are positive and significant in the hospital and private doctor equations, and negative in the clinic equation. Hence, older individuals perceive private doctor and hospital care to be of higher quality than self-care and clinic care, and self-care to be of higher quality than clinic care. The coefficients on education are positive and significant in the private doctor and hospital equations, and negative and significant in the clinic equation. The coefficient estimates imply that education increases the expected productivity of private doctor care and hospital care relative to self-care, and reduces the expected productivity of clinic care relative to self-care.

The coefficients on the acute illness (emergencies) imply that hospitals and clinics have a comparative advantage in treating these problems over private doctor or self-care. Individuals with respiratory illnesses believe that they have a comparative advantage in treating themselves. Finally, Social Security hospitals are perceived to provide higher quality than Ministry of Health hospitals, and there is perceived quality variation by region.

VI. USER FEE SIMULATIONS

In this section we use the estimated demand functions to simulate the effects of user fees. A uniform fee is imposed at public facilities (hospitals and clinics). We consider two levels of fees, 10 and 20 thousand soles. These are realistic fee levels; the average fee for a visit to a private doctor was about 20 thousand soles. Monthly demands, revenues, and compensating variations are calculated by summing the individual estimates over the sample and then extrapolating to obtain population projections. Revenues are calculated in April 1984 soles. The base for the extrapolation is the product of the regional population and the overall regional probability of having an illness. Two private markets scenarios are considered: (1) where private doctors do not adjust their prices in response to the changes in public user fees, and (2) where private doctors adjust their prices by the same amount. Further, these scenarios are analyzed under the assumption (1) that the resulting revenues are not reinvested in the health care system, and (2) that the revenues are used to reduce nonmonetary access costs.

A. User Fees Without Reinvestment

Columns 3, 4, and 5 of table 4 report the results of the aggregate user fee simulations under both scenarios. They report the cumulative percentage change in total demand, the increase in public (hospital plus clinic) revenues and the welfare loss due to the user fee increase. ^{12/} The results show that the imposition of moderate user fees can generate substantial public revenues with small reductions in the total demand for health care, but, of course, with even larger losses in consumers' welfare. Under scenario (1), for example, a user fee of 10 thousand soles generates

approximately an additional 6,386 million soles per month in public revenues accompanied by a 7.5 percent reduction in demand and a fall of 7,123 million soles in consumers' welfare. Under scenario (2), that fee generates approximately 6,516 million soles with a 12.5 percent reduction in demand and a fall of 12,460 million soles in consumers' welfare.

Even though the aggregate change in total demand appears to be modest, the effects on the lower income groups are quite large and substantially higher than in the upper income ranges. This is demonstrated in table 5 which shows the percentage change in total demand accounted for by each income quintile, and the welfare loss as a fraction of income for each income quintile. On average, the lowest income quintile accounts for about 40 percent of the total decrease in the quantity of health care demand, while the highest income quintile accounts for only about 5 percent. Not only is the reduction in total demand concentrated in the lowest income groups, but the greatest welfare loss (relative to income) is also borne by them. The simulations show that the lowest income quintile suffers a reduction of welfare of between 3 and 11 percent of income, whereas the highest income groups loses less than one half of one percent.

B. User Fees With Reinvestment

In this set of experiments we assume the government uses the revenues to reduce nonmonetary access costs. In our model nonmonetary access costs are measured by travel time. This simulation assumes that the revenues are used to reduce everyone's travel time to a public clinic and hospital to within one hour or less (i.e. to reduce the probability of traveling more than one hour to a public facility to zero). This is a fairly egalitarian change because

our data show that the median travel time probabilities are similar across all income groups.

Columns 6, 7, and 8 of table 4 report the aggregate results for the user fee experiment with reinvestment. Under both scenarios, a user fee of 10 thousand soles and a reduction of travel time to less than an hour increases total consumers' welfare, but a user fee of 20 thousand soles reduces consumers' welfare. Therefore, at a user fee somewhere between 10 and 20 thousand soles, consumers in the aggregate are indifferent between the current (1984) user fees and the higher user fees with easier access. The missing component of this comparison is whether the revenues generated by this user fee would be sufficient to cover the costs of building and operating the additional facilities necessary to reduce travel time.

Even if revenues were sufficient, such a policy would redistribute welfare from poorer to richer. This is demonstrated in table 6 which presents the percent change in total demand within each income quintile, and consumers' welfare loss as a fraction of income. An increase in user fees with reinvestment would result in a substantial decrease in demand by the poor and a slight increase in demand by the rich. In addition there would be a relatively large welfare reduction for the poor and a slight rise in welfare for the rich.

VII. SUMMARY AND CONCLUSIONS

We have derived a discrete choice model of the demand for medical care from a theoretical model that implies a natural interrelation between price and income. We show that, in the context of a discrete choice model, if health is a normal good, then the price elasticity of the demand for health

care must decline as income rises. This implies that the models in previous discrete choice studies that restrict the price effect to be independent of income are misspecified.

We estimated this model using data from a 1984 Peruvian survey, and a parsimonious flexible function form. Unlike previous studies, we find that price plays a significant role in the demand for health care, and that demand becomes more elastic as income falls, implying that user fees would reduce the access to care for the poor proportionally more than for the rich. Our simulations show that user fees can generate substantial revenues, but are accompanied by substantial reductions in aggregate consumer welfare, with the burden of the loss on the poor. These results demonstrate that user fees would be regressive both in terms of access and welfare.

The simulations indicate that the welfare loss for some people having to travel more than an hour to a public health care facility is roughly equal to the expected welfare loss from moderate user fees, and the first loss is fairly evenly distributed across income groups. Hence, if the government imposed moderate user fees and used the revenues to solve this access problem, there would be little if any aggregate welfare loss, but there would be a redistribution of welfare from poor to rich. This result is what one would expect in an urban environment where services are fairly evenly distributed, and may not be applicable to rural areas.

We have found that the introduction of user fees in Peru has the potential for raising significant revenues for cost recovery by shifting the financial burden (and commensurate welfare loss) of the health care system from taxpayers to users. We also show that user fees are regressive both in terms of access and welfare. In essence, the health care financing dilemma

for developing nations is that the improvement in allocative efficiency and cost recovery from user fees are accompanied by a redistribution of welfare from poorer to richer. A natural solution to this dilemma is to introduce user fee schedules that increase with ability to pay. This type of price discrimination may generate substantial revenues with minimum welfare loss, if administrative costs are contained.

FOOTNOTES

We gratefully acknowledge financial support from The Living Standards Unit of the World Bank and USAID, and note that the views expressed herein are those of the authors alone and not of the sponsoring organizations. We are also indebted to John Akin, Jim Brown, Angus Deaton, Avi Dor, Paul Glewwe, Charles Griffiths, Phil Musgrove, John Newman, Mead Over, Cesar Penaranda, T. Paul Schultz, Morton Stelcner, John Strauss, Pravin Trivedi, Jacques van der Gaag, Juan Fernando Vega, and the participants of seminars at Harvard, Johns Hopkins, SUNY at Stony Brook, Yale, and the World Bank for valuable comments.

- 1/ See de Ferranti (1985) for a discussion of health care pricing methods in developing countries.
- 2/ Recently, the pros and cons of such proposals have been discussed in de Ferranti (1985), and Jimenez (1986).
- 3/ Studies of the demand for health care in developing countries include Akin et. al. (1985 and 1986), Birdsall and Chuhan (1986), Heller (1983), and Mwabu (1987).
- 4/ The feasibility condition requires income to be at least as large as the price of the alternative. The constraining level of income depends on the length of time over which individuals are able to budget. For example, if capital markets are perfect, the budget period is the individual's lifetime and the constraining income the present value of lifetime income. On the other hand, if there are cash constraints, the budgeting period could be as short as the interval in which the individual is paid. In section III.C, we propose a procedure which parameterizes the length of the budgeting period and allows it to be estimated.
- 5/ If, in fact, income is endogenous, there is a possibility of simultaneity bias. The simultaneity bias arises because an accident or illness may reduce income. We argue in section V that the bias is likely to have a downward impact on the estimated price and income effects, making them closer to zero. Hence, our estimated price elasticities should be lower bounds on the true elasticities.
- 6/ For example see Akin et. al. (1985 and 1986), Mwabu (1986), and Birdsall and Chuhan (1986).
- 7/ An obvious extension to the semi-translog is to include interactions and squared terms for health and nonmonetary cost terms. The problem with this is that the health terms, as will be discussed in a moment, will be a function of variables whose coefficients necessarily vary by alternative. Hence, this extension would require a substantially larger parameter space. Since the major objective of this study is to analyze price elasticities, we require the most flexibility in the parameterization of the consumption term. In addition, this

specification would violate the necessary conditions for the model to be consistent with utility maximization specified in McFadden (1981). This point is taken up further in footnote 9.

8/ See Deaton and Muellbauer (1980) for discussion of compensating variation and other welfare measures.

9/ In order for (12) to be exact, the marginal utility of income, λ , must be independent of alternative specific characteristics and price. See McFadden (1981) and Small and Rosen (1981) for more discussion on this point. Although λ is independent of quality, it is not independent of price. Specifically

$$\lambda = (\alpha_1 + \alpha_2 \ln(Y - P)) / (Y - P) ,$$

and

$$\partial \lambda / \partial P = (2\alpha_2 (\ln(Y - P) - 1) - \alpha_1) / (Y - P)^2 .$$

In most cases this term is likely to be small relative to λ , as the denominator is approximately income squared. Hence, λ is likely to be approximately constant across small differences in price. If indeed $\partial \lambda / \partial P$ is small, then each individual's average marginal utility of income over his/her alternatives is a good approximation of λ . Since this approximation is calculated for each individual, λ will vary greatly across individuals as there is substantial variation in income.

10/ A full description of the hedonic price and travel time methodologies and resulting estimates is provided in the Appendix.

11/ The estimated σ was 1.02 with a standard error of 0.86. The test statistic for the hypothesis that σ equals unity is 0.03 and is distributed student t. The critical value at the 0.05 level is 1.96. The test statistic for the null hypothesis that $k=1$ is 1.06 and is distributed $X^2(1)$. The corresponding critical value at the 0.05 level is 3.84. Our linearization of the log consumption term biases the estimate of k towards zero. However, the observed bias is minuscule when evaluated at the mean of the data.

12/ As discussed in footnote 9, the marginal utility of income, λ , is not constant across alternatives. Each individual's average over the three alternatives is a good approximation if the variation in λ across alternatives is small. In our simulations, the largest price difference across alternatives is 19 thousand soles. At the mean income level with a price of 1 thousand soles λ is 0.0111, and at a price of 20 thousand soles λ is 0.0115; a difference of 0.0004. This difference declines with income, implying that the goodness of the approximation increases with income. The approximation is poor only at very low levels of income.

APPENDIX

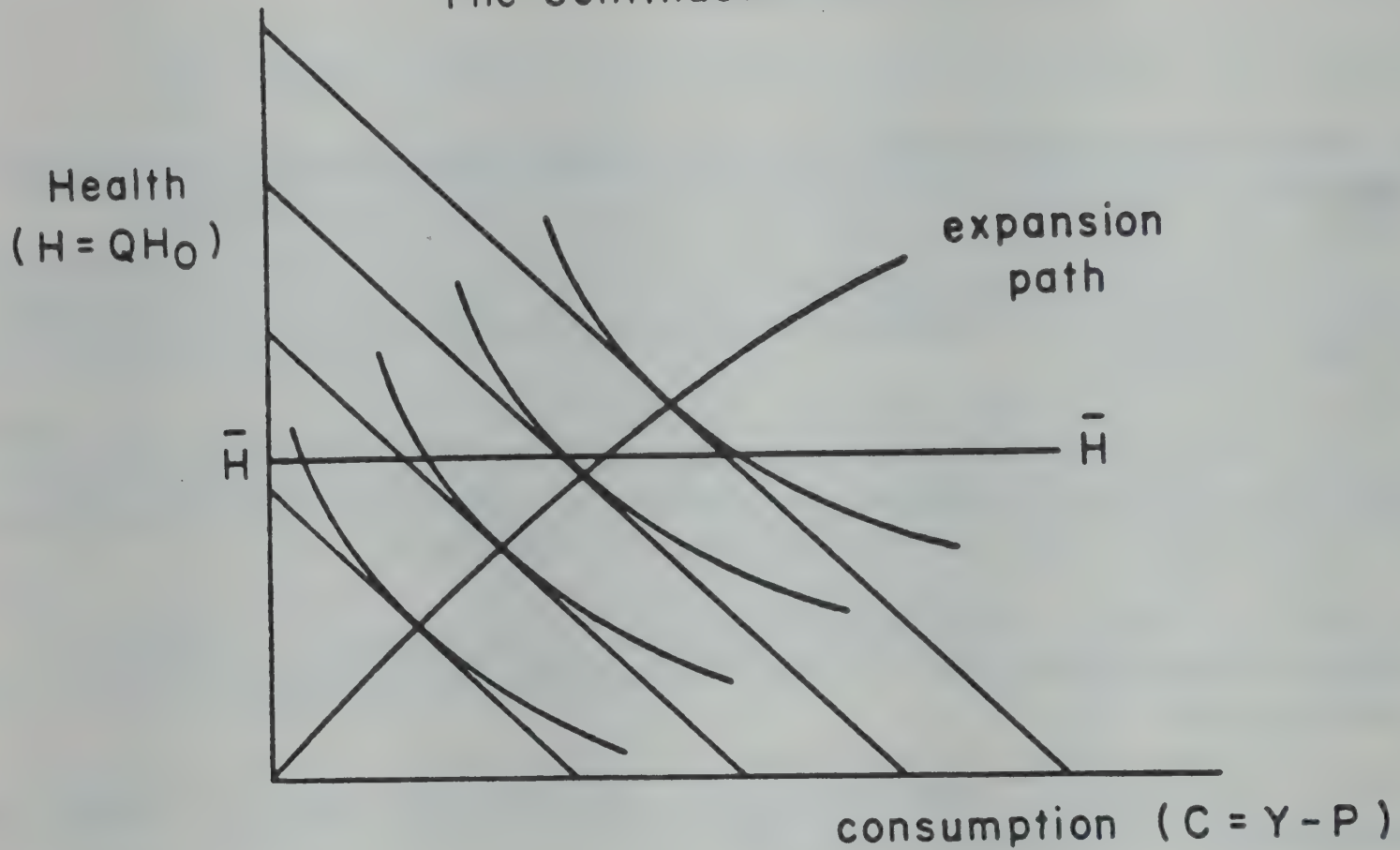
The hedonic private doctor price equation specifies the price of a single visit to be a function of the type of illness, age of the individual, and characteristics of the market. The market variables include the number of doctors, the number of hospital beds, the number of clinics, and the population of the district in which the individual lives. We correct for sample selection bias using a methodology derived in Dubin and McFadden (1982). This requires the estimation of a reduced form multinomial logit model of provider choice, from which a set of Dubin-McFadden selection correction terms are constructed (predicted) for each individual. The predicted correction terms are included as regressors in the hedonic price regression. Separate models are estimated for Lima and the Sierra. The market variables are not included in the Lima regression as there is no variation. The estimated coefficients and t-statistics are presented in table A.

The hedonic travel time equations for private doctors, hospitals, and clinics specify the time it takes to travel to a provider to be a function of the market variables, the location of the individual, a dummy variable indicating whether the main road in the district is paved, and the Dubin-McFadden selection correction terms. An additional problem arises because we only observe if the individual traveled more or less than an hour. The hedonic travel time equations were estimated as binary logits. Separate Lima and Sierra models were estimated for private doctors and hospitals, and, due to small sample sizes, a single pooled model was estimated for clinics. The estimated coefficients and t-statistics are also presented in table A.

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The Continuous Choice Case



The Discrete Choice Case

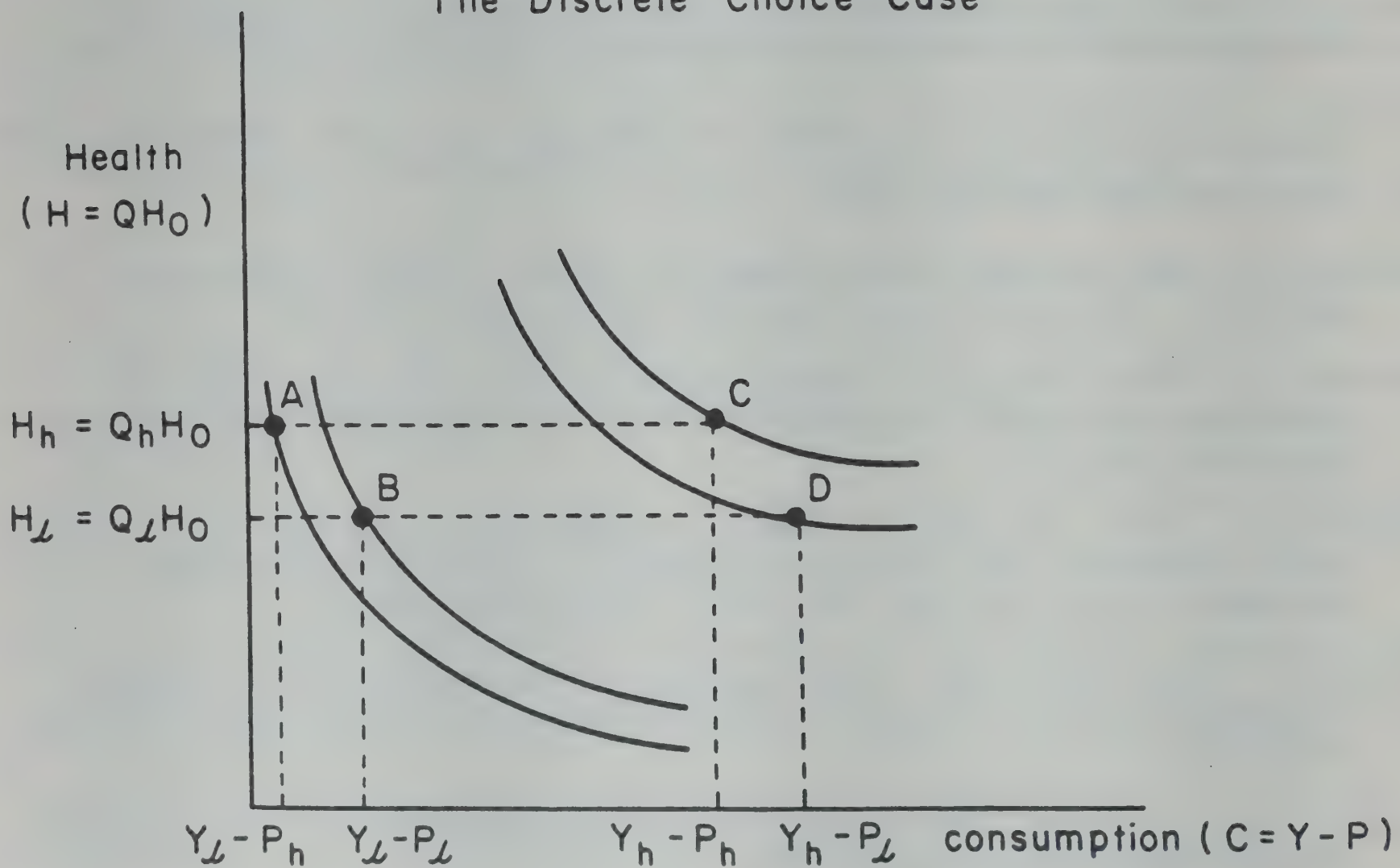


Table 1
Summary Statistics (N=3412)

Variable	Mean	Standard Deviation
Went to a public clinic (past 14 days)*	0.05	(0.22)
Went to a public hospital (past 14 days)*	0.11	(0.32)
Went to a private doctor (past 14 days)*	0.09	(0.29)
Age	39.18	(17.57)
Years of Education	7.73	(4.82)
Social Security*	0.15	(0.36)
Acute illness (past 14 days)*	0.05	(0.22)
Respiratory illness (past 14 days)*	0.15	(0.35)
Digestive illness (past 14 days)*	0.45	(0.50)
Resident of Lima*	0.37	(0.48)
Resident of South Cone*	0.10	(0.30)
Resident of North Cone*	0.22	(0.41)
Resident of South Sierra*	0.08	(0.27)
Resident of North Sierra*	0.15	(0.36)
Price of visit to private doctor**	19.01	(7.54)
Monthly income**	426.45	(1070.39)
Prob. travel time to clinic > 1 hour	0.01	(0.03)
Prob. travel time to hospital > 1 hour	0.13	(0.26)
Prob. travel time to private doctor > 1 hour	0.07	(0.14)

* Dummy variables (= 1 if answer is yes, = 0 otherwise).

** In 1,000's of April, 1984 soles.

Table 2
Multinomial Logit Estimated Coefficients and t-Statistics

Variable	Hospital	Clinic	Private Doctor
Log Consumption*	-2.77 (1.81)	-2.77 (1.81)	-2.77 (1.81)
Log Consumption Squared*	0.62 (2.40)	0.62 (2.40)	0.62 (2.40)
Travel Time*	-2.05 (3.44)	-2.05 (3.44)	-2.05 (3.44)
Age	0.01 (4.35)	-0.01 (1.67)	0.01 (2.53)
Education	0.04 (2.77)	-0.05 (2.10)	0.05 (3.91)
Acute Illness	0.78 (3.87)	0.83 (2.77)	-0.29 (0.90)
Respiratory Illness	-0.64 (5.19)	-0.37 (1.49)	-0.74 (5.42)
Digestive Illness	0.09 (0.59)	0.32 (1.49)	-0.17 (0.95)
Lima	0.22 (1.11)	1.21 (2.71)	-0.10 (0.46)
South Cone	0.53 (1.62)	1.69 (3.58)	0.02 (0.08)
North Cone	0.36 (1.50)	1.31 (2.91)	-0.45 (1.94)
South Sierra	0.63 (2.33)	0.78 (1.51)	-0.05 (0.18)
North Sierra	-0.07 (0.26)	1.19 (2.52)	-0.00 (0.01)
Social Security	0.77 (5.55)	-	-
Constant	-2.72 (8.70)	-3.12 (5.71)	-1.99 (6.32)

* The coefficients are restricted to be equal across equations.

Table 3
Arc Price Elasticities by Income Quintile

User Fee Change*	Quintile 1 (lowest)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (highest)
Clinic 0-10	-0.17	-0.12	-0.09	-0.06	-0.03
10-20	-0.62	-0.42	-0.23	-0.15	-0.09
20-30	-1.43	-0.58	-0.38	-0.26	-0.14
Hospital 0-10	-0.15	-0.12	-0.08	-0.05	-0.03
10-20	-0.57	-0.34	-0.23	-0.15	-0.09
20-30	-1.52	-0.56	-0.39	-0.26	-0.13
Private 0-10	-0.17	-0.12	-0.07	-0.06	-0.03
Doctor 10-20	-0.53	-0.35	-0.21	-0.14	-0.08
20-30	-1.36	-0.60	-0.35	-0.25	-0.12

* Reported in thousands of April, 1984 soles.

Table 4
User Fee Simulations - Aggregate Results

Scenario	No Revenue Reinvestment				With Revenue Reinvestment		
	User* Fee Change	Cum % in Total Demand	Public** Revenue Increase	Welfare** Losses	Cum % in Total Demand	Public** Revenue Increase	Welfare** Losses
No Private Doctor	1-10	-7.5	6,386	7,123	+0.5	7,006	-7,354
Price Response	1-20	-14.3	11,306	13,872	-7.3	13,686	569
Equal Pri. Doctor	1-10	-12.5	6,516	12,460	-4.4	7,756	-2,160
Price Response	1-20	-23.9	11,906	23,957	-16.6	14,126	10,407

* Reported in thousands of April, 1984 soles.

** Reported in millions of April, 1984 soles.

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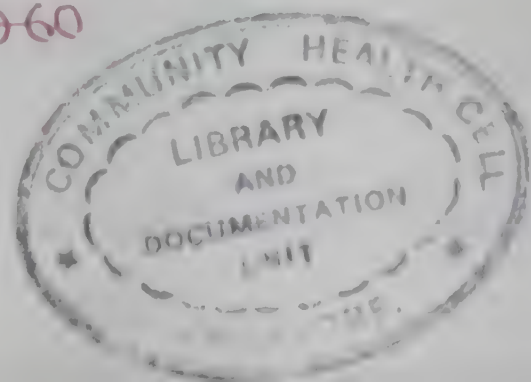


Table 5
User Fee Simulations - Distributional Results (No Revenue Reinvestment)
Percentage Change in Total Demand Accounted for by Each Income Quintile and
Consumers' Welfare Loss as a Percentage of Income by Income Quintile

Scenario	User* Fee Change	Quintile 1 (lowest)		Quintile 2		Quintile 3		Quintile 4		Quintile 5 (highest)	
		A*	B**	A	B	A	B	A	B	A	B
No. Pri. Doctor	1-10	38.4	3.0	29.3	1.2	16.2	0.6	11.1	0.4	5.0	0.1
Price Response	1-20	37.6	6.2	26.5	2.3	17.5	1.2	12.1	0.7	6.3	0.2
Equal Pri. Doctor	1-10	39.2	6.1	25.3	1.9	16.9	1.0	12.0	0.6	6.6	0.2
Price Response	1-20	38.1	11.2	24.7	3.5	17.2	2.0	13.1	1.3	6.9	0.5

* A = Percentage Change in Total Demand Accounted for by Each Quintile.

** B = Consumers' Welfare Loss as a Percentage of Income by Quintile.

Table 6
User Fee Simulations - Distributional Results (With Revenue Reinvestment)
Percentage Change in Demand by Income Quintile and
Consumers' Welfare Loss as a Percentage of Income by Income Quintile

Scenario	User* Fee Change	Quintile 1 (lowest)		Quintile 2		Quintile 3		Quintile 4		Quintile 5 (highest)	
		A*	B**	A	B	A	B	A	B	A	B
No Pri. Doctor	1-10	-7.5	1.7	-2.9	0.4	2.3	-0.1	3.8	-0.3	6.1	-0.6
Price Response	1-20	-23.8	4.9	-14.1	1.7	-6.2	0.6	-0.8	0.1	3.8	-0.4
Equal Pri. Doctor	1-10	-18.7	4.5	-9.4	1.1	-2.8	0.3	1.0	-0.1	4.1	-0.4
Price Response	1-20	-44.8	10.0	-26.0	2.9	-13.8	1.3	-7.1	0.6	1.0	-0.2

* A = Percentage Change in Demand Within Each Quintile.

** B = Consumers' Welfare Loss as a Percentage of Income Within Each Quintile.

Table A
Hedonic Price and Travel Time Repressions

Independent Variable	Private Doctor Price		Private Doctor Travel Time		Hospital Travel Time		Clinic Travel Time
	Lima	Sierra	Lima	Sierra	Lima	Sierra	
Constant	1.99 (3.50)	3.78 (6.51)	2.14 (1.79)	0.71 (0.39)	1.88 (2.28)	0.95 (0.49)	3.29 (2.05)
Age	0.18 (0.94)	0.46 (2.48)	-	-	-	-	-
Acute Illness	0.34 (0.73)	-0.54 (1.06)	-	-	-	-	-
Respiratory Illness	0.12 (1.02)	0.07 (0.50)	-	-	-	-	-
Digestive Illness	-0.07 (0.41)	-0.23 (1.01)	-	-	-	-	-
North Cone of Lima	-0.14 (0.87)	-	0.45 (0.97)	-	-0.34 (1.13)	-	1.99 (1.69)
South Cone of Lima	-0.14 (0.96)	-	-0.64 (1.52)	-	-0.91 (2.46)	-	-1.12 (1.47)
North Sierra	-	-0.72 (2.57)	-	-0.46 (0.72)	-	1.76 (1.31)	-0.33 (0.47)
South Sierra	-	-0.25 (0.60)	-	-0.31 (0.29)	-	1.46 (1.37)	-0.16 (0.47)
# of Doctors in District	-	-0.01 (1.25)	-	0.03 (1.68)	-	-	-
# of Hospital Beds in District	-	-0.00 (3.40)	-	-	0.01 (1.98)	-	-
# of Clinics in District	-	-0.18 (3.66)	-	-	-	-	-
District Population	-	2.42 (1.46)	-	4.72 (2.11)	-	5.13 (2.51)	-
District Pop. Sq'd.	-	-2.72 (2.11)	-	-1.86 (1.45)	-	-2.88 (2.50)	-

Table A
Hedonic Price and Travel Time Regressions
(Continued)

Independent Variable	Private Doctor Price		Private Doctor Travel Time		Hospital Travel Time		Clinic Travel Time
	Lima	Sierra	Lima	Sierra	Lima	Sierra	
Good Road Dummy	-	-	-	1.30 (2.04)	-	0.66 (1.05)	0.86 (1.73)
Hospital Selection Term	-1.51 (1.99)	-0.64 (1.09)	2.25 (1.43)	1.91 (0.74)	-	-	3.80 (1.39)
Clinic Selection Term	2.21 (2.54)	1.99 (2.20)	-1.07 (0.63)	-2.21 (1.01)	-1.41 (1.09)	-5.13 (1.33)	-
Private Doctor Selection Term	-	-	-	-	2.07 (1.22)	-0.75 (0.22)	-4.57 (1.39)
Self-Care Selection Term	-0.62 (1.04)	-0.80 (1.28)	-0.83 (0.57)	0.22 (0.12)	-0.36 (0.24)	5.42 (1.54)	0.88 (0.47)

II Non-Price Rationing for Medical Care; The Case of Cote d'Ivoire

I. Introduction

Many developing countries have created extensive publicly supported health care systems, whose services are typically provided at little or no monetary cost. The rationale behind these subsidies is to insure that all income groups have equal access to medical care.^{1/} However, in the absence of user fees (access charges), equal access is still not assured. It has been well known since Acton (1975) that indirect access prices, such as travel time, are important determinants of health care choices, and when direct prices are small, these indirect costs become the dominant rationing device. Travel time is expected to be a particularly powerful rationing device in poor developing countries, where the majority of the population inhabit rural areas and health infrastructures are concentrated in cities. The purpose of this paper is to investigate the impact of travel time on the demand for health care in rural Côte d'Ivoire.

Most of the previous studies on the demand for medical care in developing countries have found little if any impact of prices and travel time on demand. These studies model the demand for health care as a discrete choice amongst alternative providers, with the price effect specified to be independent of income.^{2/} This assumption is extremely restrictive, since one would expect the wealthy to be less sensitive to price differences amongst providers than the poor. Gertler, Locay, and Sanderson (1986) show that this specification is inconsistent with stable utility maximization, and that the price elasticity of demand must decline with income for health to be a normal good. They derive a discrete choice specification from a theoretical model that implies a natural interaction between price and income in the demand functions. Their empirical results for Peru show that prices are important

determinants of health care demand, and that demand indeed becomes more elastic as income falls.

All of the previous studies specify access costs such as travel time as a non-monetary nuisance parameter in the utility function, implying that their coefficients are interpreted as the marginal disutility of traveling. Acton (1975) points out that the monetary outlays associated with these access costs should enter the budget constraint in the same way as the direct price of medical care. This study extends the specification in Gertler, Locay, and Sanderson (1986) by including access costs directly in the budget constraint as well as a non-monetary nuisance parameter in the utility function.

Previous studies also estimate a Multinomial Logit (MNL) discrete choice model. The MNL suffers from the Independence of Irrelevant Alternatives property which restricts the cross-price elasticities to be equal across alternatives. Instead, we employ a Nested Multinomial Logit (NMNL) specification which allows non-equal cross-price elasticities and has the MNL nested as a special case. Further, we estimate the NMNL by Full Information Maximum Likelihood (FIML) rather than the more popular two-step procedure. Hensher (1986) reports that FIML achieves large efficiency gains over the two-step procedure for NMNL.

The model is estimated using data from the World Bank's Living Standards Measurement Survey of Côte d'Ivoire. Our findings indicate that travel time plays an important role in determining health care utilization both as a price and as a nuisance parameter. The results also show that health care demand amongst poorer individuals is substantially more travel time elastic than amongst richer individuals. Further, specification tests reject the MNL in favor of the NMNL.

The paper is organized as follows. In Section II and III we develop the model and the empirical specification. The data and institutional environment are discussed in Section IV. The results are presented in Sections V and VI. Finally a short summary is provided in Section VII.

II. Behavioral Assumptions

The framework for this discussion is a model in which utility depends on health and the consumption of goods other than medical care. Health is valued both as a consumption good and as an investment in productivity. If an illness or accident is experienced, individuals must decide whether to seek medical care. The benefit from consuming medical care is an improvement in health, and the cost of medical care is a reduction in the consumption of other goods. Individuals have to decide not only whether to seek care, but also what type of care. They are faced with a set of alternative providers, each of which has a different potential impact (efficacy) on their health. This efficacy depends on providers' skills, individuals' characteristics (e.g. medical problems, general health status, and ability to implement the recommended treatment plan), and a random term that captures the notion that the efficacy of medical care is not deterministic. An individual's expectation of this impact can be viewed as the perceived quality of care.

In essence, individuals are faced with a discrete choice decision. A choice must be made between the various provider alternatives, including self-care. Each alternative offers a set package (quality) for a given price, where the price includes both monetary outlays and access costs such as travel and waiting time. Access costs enter the utility maximization problem in both monetary and non-monetary forms. They enter in monetary form via the budget

constraint, and in non-monetary form as a nuisance argument of the utility function. For example, the cost of traveling to a provider is a monetary access cost and the disutility from the time spent traveling is a non-monetary access cost. Based on this information, their health status, types of medical problems, and incomes, individuals choose the alternative that yields the greatest utility.

The utility maximization problem is specified as a two stage budgeting process. Utility is assumed to be separable in health and non-medical consumption. Individuals first decide how to divide their budget between health care and other consumption, and then choose the components of their consumption bundles. Since we are only concerned with the first stage, total expenditures on non-medical goods enter the utility function directly.

Formally, let utility conditional on receiving care from provider j , be given by

$$(1) \quad U_j = U(H_j, C_j, T_j),$$

where H_j is expected health status after receiving treatment from provider j , C_j is expenditures on consumption after paying provider j , and T_j is the travel time to provider j .

The health care purchased from provider j is invested in health. The perceived quality (marginal product) of provider j 's medical care is the expected improvement in health. Let H_0 be expected health status without professional medical care (i.e. self-treatment). Then, the perceived quality of provider j 's care is

$$Q_j = H_j/H_0,$$

which yields an expected health care production function of the form

$$(2) \quad H_j = Q_j H_0,$$

where H_j is proportional to H_0 . This production function takes on a rather simple form for the self-care alternative. Since H_j equals H_0 , the proportionality factor is unity for the self-care alternative. In effect, this normalizes the health care production function so that the quality of a particular provider's care is measured relative to efficacy of self-care.

Let P^*_j be the total monetary price of provider j 's care and Y be income, then the budget constraint is

$$(3) \quad C_j + P^*_j = Y,$$

with $C_j \geq 0$ required for feasibility. The consumption of medical care is an investment in productivity, which affects income. In rural farming households, this period's work determines next period's income. Hence, this period's income is exogenous to this period's health care decisions.

The total price of medical care includes both the direct payment to the physician and the price of access (e.g. the cost of travel time). Substitution of (3) into (1) for C_j yields the conditional indirect utility function

$$U_j = U(H_j, Y - P^*_j, T_j).$$

Notice that income affects utility through the consumption term, and that the price of medical care is foregone consumption.

Now we are ready to specify the utility maximization problem.

Suppose the individual has $J+1$ feasible alternatives (with the $j=0$ alternative being self-care). The unconditional utility maximization problem is

$$(4) \quad U^* = \max(U_0, U_1, \dots, U_J),$$

where U^* is the highest utility the individual can attain.

If health is a normal good, then the demand for health increases with income. A necessary condition for normality is that as income rises, the marginal rate of substitution of consumption for health diminishes, holding health constant. This point is demonstrated in figure 1, where the continuous choice case is pictured. As income rises the point of utility maximization moves out from the origin along the expansion path. Holding health constant at \bar{H} , we move to the right along the horizontal line as income rises. Thus, as income rises, the \bar{H} line intersects the indifference curves at points of flatter slopes, implying a diminishing marginal rate of substitution.

In a discrete choice world, health being a normal good implies that as income rises individuals are more likely to choose the higher price/higher quality options. This demonstrated in figure 2, where the discrete choice case is pictured. In figure 2, there is a choice between a high price/high quality option (Q_h, P_h) , and a low quality/low cost option (Q_l, P_l) . At a low income level, say Y_1 , the choice is between points A and B [i.e. between a gain in health of $(H_h - H_l)$ and a gain in consumption of $(P_h - P_l)$]. At income Y_1 , the gain in consumption is preferred to the gain in health and the

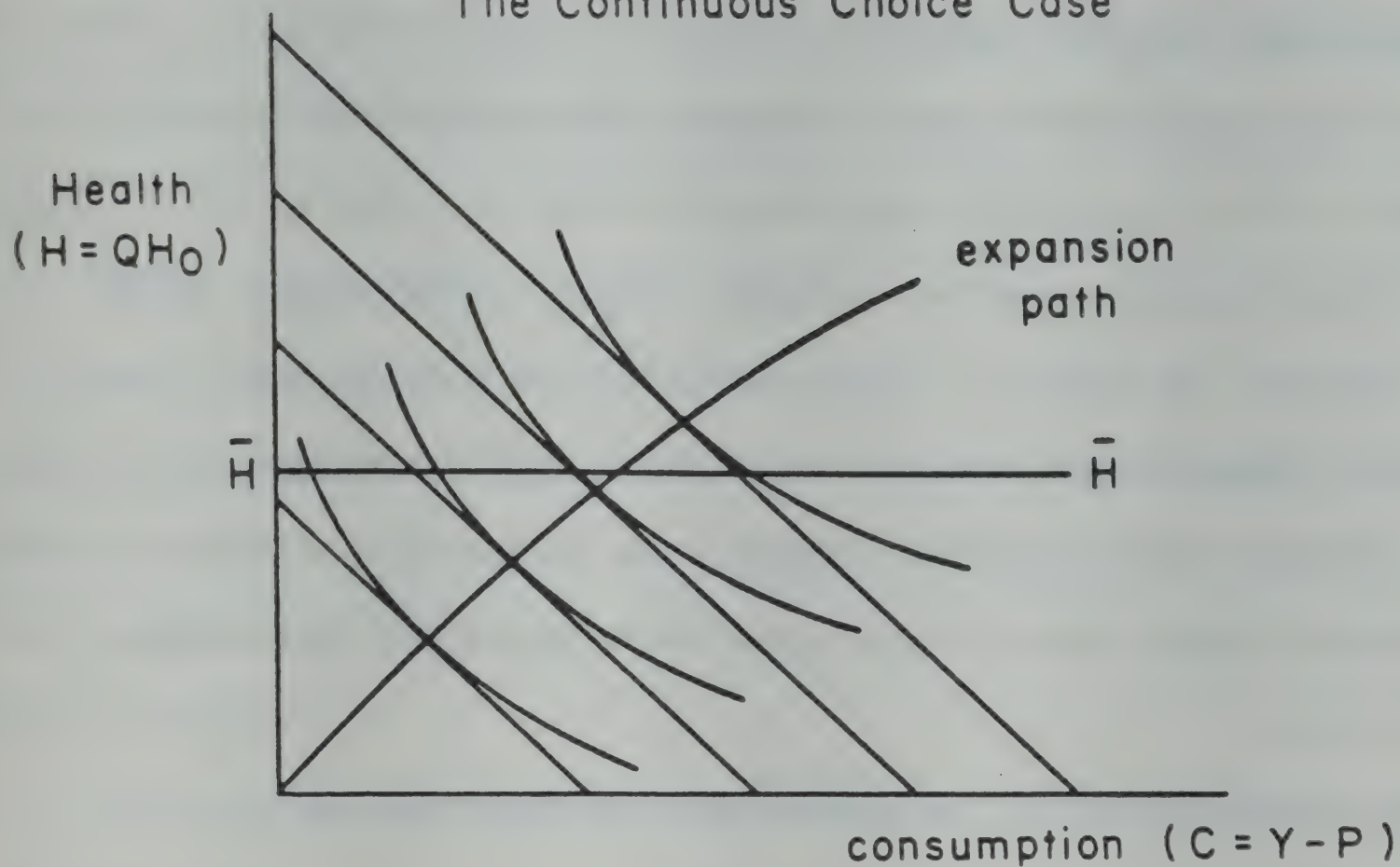
low cost/low quality option B is chosen. As income rises the marginal rate of substitution of consumption for health falls along both horizontal lines H_h and H_1 . Hence, as income rises the marginal utility of health relative to consumption rises. Eventually (at income Y_h in figure 2) the gain in health is preferred to the gain in consumption, and the high quality/high price option C is chosen.

Therefore, in a discrete choice world, if health is a normal good, a rise in income increases the likelihood that individuals purchase higher quality/higher cost alternative. Another way of looking at this is that an increase in price is less likely to dissuade richer individuals from choosing the higher quality/higher cost alternatives. In a probabilistic sense, this implies that richer individuals are less price elastic than poorer individuals.

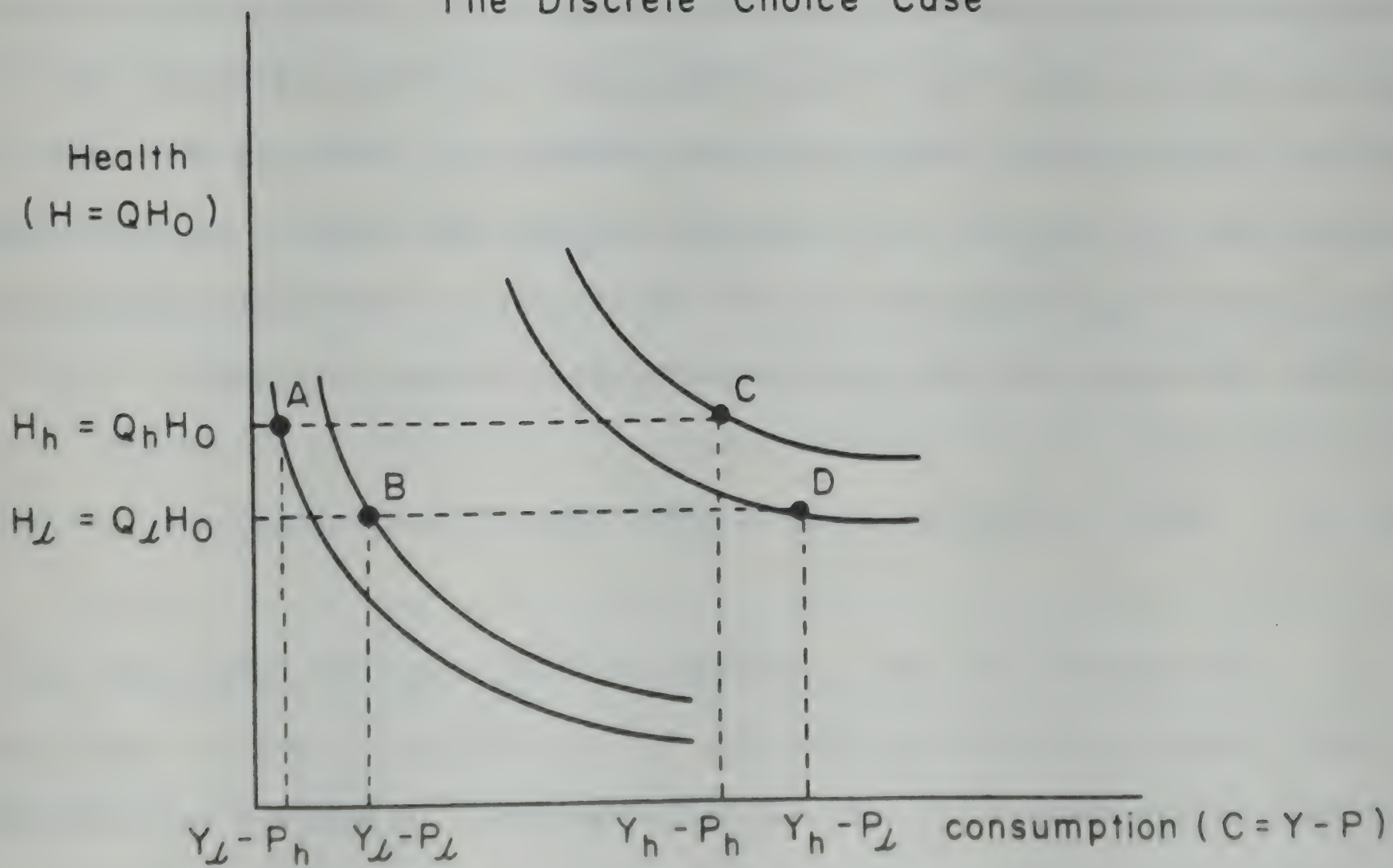
III. Empirical Specification

The solution to (4) yields a system of demand functions, whose forms will be probabilities that the alternatives are chosen. The probability that a particular alternative is chosen equals the probability that this alternative yields the highest utility amongst all the alternatives. The functional form of the demand functions depends on the functional form of the conditional utility function and the distribution of the stochastic variables.

The Continuous Choice Case



The Discrete Choice Case



A. The Conditional Utility Function

As discussed in the previous section, the conditional utility function must allow for a diminishing marginal rate of substitution. Since a linear function imposes a constant marginal rate of substitution, it is rejected. Further, we reject a linear specification with provider specific coefficients on consumption, as that would imply that the marginal rate of substitution varies by alternative for the same values of quality, price and income. A specification that avoids these pitfalls is the Cobb-Douglas utility function.

The arguments of the j th conditional utility function are the expected level of health after receiving care from provider j , consumption of non-medical care goods, and the travel time nuisance parameter. At this point it is convenient to specify utility to be explicitly a function of health as a consumption good and of health as an investment in earnings ability. The return to health as an investment, is its productivity effect on next year's income. Let Y_{2j} , be next year's expected income conditional on the individual having health H_j . Substitution of (2) and (3) into a Cobb-Douglas conditional utility function yields the conditional indirect utility function.

$$(5) \quad U_j = \ln(H_0) + \ln(Q_j) + \alpha_1 \ln(Y - P_j^*) + \alpha_2 \ln(T_j) + \alpha_3 \ln(Y_{2j})$$

In equation (5), $\ln(H_0)$, $\ln(Q_j)$ and $\ln(Y_{2j})$ are not observed. Since $\ln(H_0)$ appears in the utility function for all the choices and its value does not vary by alternative, it does not influence which alternative is preferred, and therefore can be ignored. To get around the unobservability of $\ln(Q_j)$,

we specify a quality (marginal product) function for each provider type.

Specifically, let the expected quality from provider j be

$$(6) \quad \ln(Q_j) = \beta_{0j} + \beta_{1j}X + \beta_{2j}Z_j + \epsilon_j,$$

where X is a vector of the individuals' characteristics (e.g. measures of health status, severity of illness, education), Z_j is a vector of characteristics of provider j , and ϵ_j is a zero mean random disturbance with finite variance.

A similar approach is used to bypass the unobservability of $\ln(Y_{2j})$. Next period's income is determined from the household production function, which is a function of the levels of inputs (e.g. labor, land, capital, rain, etc.). The marginal productivity of any of the inputs depends on the individual's health. Since health depends on the productivity of the medical care consumed, the parameters of the function vary by alternative. As was done with quality, we normalize the health investment effect relative to the self-care alternative. This involves differencing $\ln(Y_{2j})$, income in year 2 after provider j is chosen, from $\ln(Y_{20})$, income in year 2 after the self-care alternative is closer. Let the return in terms of next year's income of provider j 's care relative to self-care be given by

$$(7) \quad \ln(Y_{2j}) = \ln(Y_{20}) + \gamma_{0j} + \gamma_{1j} \ln(S),$$

where S is the vector of farm inputs.

The reduced form conditional utility function for alternative j is found by substituting (6) and (7) into (5). Specifically, for alternatives $j=1, \dots, J$, the conditional utility function is

$$(8) U_j = (\beta_{0j} + \gamma_{0j}) + \beta_{1j}X + \beta_{2j}Z_j + \alpha_1 \ln(Y - P_j^*) + \alpha_2 \ln(T_j) + \gamma_{1j} \ln(S_j) + \epsilon_j$$

Note that the intercept and the coefficients of X , Z and S vary by alternative, as do the values of consumption and access costs (but not their coefficients). The restrictions that H_j equals H_0 , that the coefficients of the farm inputs are normalized relative to the self-care alternative, and that P_0 is assumed to be zero imply that the conditional utility function for the self-care alternative reduces to

$$U_0 = \alpha_1 \ln Y + \epsilon_0.$$

B. The Budget Constraint

The full price of provider j 's medical care is

$$(9) P_j^* = P_j + wT_j.$$

where P_j is the direct payment to provider j and w is the opportunity cost of time. Substitution of (9) into the conditional utility function in (8) yields

$$(10) U_j = \beta_{0j} + \gamma_{0j} + \beta_{1j}X + \beta_{2j}Z_j + \alpha_1 \ln(Y - P_j - wT_j) + \alpha_2 \ln(T_j) + \gamma_{1j} \ln(S) + \epsilon_j$$

In order to simplify the estimation we use an approximation to the log of consumption. The log of consumption can be expressed as

$$(11) \quad \ln(Y - P_j - wT_j) = \ln(Y) + \ln(1 - (P_j + wT_j)/Y)$$

Since $(P_j + wT_j)/Y$, the budget share of alternative j , is expected to be small, the second term in (11) can be approximated by $-[(P_j + wT_j)/Y]$. Substitution into (10) for the log consumption term yields

$$(12) \quad U_j = V_j + \epsilon_j$$

where

$$(13) \quad V_j = \beta_{0j} + \gamma_{0j} + \beta_{1j}X + \beta_{2j}Z_j + \alpha_1 \ln(Y) - \alpha_1[(P_j + wT_j)/Y] + \alpha_2 \ln(T_j) + \gamma_{1j} \ln(S)$$

Notice that the $\alpha_1 \ln(Y)$ term in (13) is the same across all alternatives, including self-care. Since only differences in utility across alternatives matter, this term has no effect on provider choice, and therefore, can be omitted. Thus, the deterministic portion of the self-care utility function reduces to $V_0 = 0$.

Earnings affect the model in two ways. First, as discussed above, income enters the budget constraint, and second, the wage rate enters via the access cost as the value of time. The access cost to a provider is the product of the individual's wage rate (value of time) and the time spent traveling to see the provider. If health is a normal good, then an increase in income, holding the wage constant, raises the probability that the high

quality/high cost alternative is chosen. Alternatively, an increase in the wage rate, holding income constant, is tantamount to a price rise, thus reducing the probability that the provider is chosen.

C. The Demand Functions

The demand function for an alternative is the probability that its utility is greater than from any of the other alternatives. Previous studies have assumed that these demand functions take on a multinomial logit (MNL) form. As discussed in McFadden (1981), the MNL suffers from the Independence of Irrelevant Alternatives assumption. This assumption is equivalent to assuming that the conditional utility functions are uncorrelated across alternatives, and imposes the restriction that the cross-price elasticities are the same across alternatives. A computationally feasible generalization to the MNL is the Nested Multinomial Logit (NMNL), (McFadden, 1981). The NMNL allows correlation across subgroups of alternatives, and therefore, non-constant cross-price elasticities across subgroups. Another advantage of the NMNL is that the MNL is nested within it, providing us with a specification test.

The health care choices in the Côte d'Ivoire data set are hospital, clinic, and self-care. Let us group the hospital and clinic alternatives together, and allow the conditional utility functions to be correlated for these alternatives. In this case, the self-care demand function (i.e. the probability of choosing self-care) is:

$$\Pi_0 = \frac{\exp(V_0)}{\exp(V_0) + \exp(\sigma I)}$$

and the probability of choosing provider j is:

$$\pi_j = \left(\frac{\exp(\sigma I)}{\exp(V_0) + \exp(\sigma I)} \right) \left(\frac{\exp(V_j)}{\exp(I)} \right),$$

where

$$I = \log \left(\sum_{k=1}^J \exp(V_k) \right),$$

and V_j is given in (13). Since $V_0 = 0$, $\exp(V_0) = 1$. The coefficient σ in the demand equations is one minus the correlation of the hospital and clinic conditional utility functions. When $\sigma = 1$, the NMNL reduces to an MNL.

IV. Data

The data used in this study are drawn from the Ivorian Living Standard Survey (ILSS). This multi-purpose household survey, which aims at measuring many socioeconomic factors relevant to the living standards of Ivorian households, was started in February 1985.^{3/} During the first 12 month period, 1588 households were interviewed of which 950 were located in rural areas. Approximately 93 percent of these households are farming households. The other households were deleted from the sample. Detailed information on health-care utilization was obtained from all household members who reported an illness or injury during the four weeks prior to the interview. The ILSS also contains extensive information on many socioeconomic aspects relevant to the demand for medical care.

In addition to household data, the ILSS collected community level information in rural areas. The rural component of the household survey was

comprised of 56 sample clusters, which roughly correspond to small villages. However, the community survey was completed in only 52 rural clusters. Relevant to the current study is the data on the availability of various types of health care facilities and community wage rates. Travel time is reported for the nearest available facility of each type (hospital, clinic, maternity center, etc.). When a provider is available in the village, travel time is recorded as zero. In addition, male and female agriculture wage rates were collected for each community.

The final estimation sample is drawn from the pool of adults in 49 clusters or villages, and contains 1030 individuals over the age of 15. Four clusters were excluded either because travel times were not known or because they were obviously misreported. Further, since the study focused on primary health care, visits associated with obstetric care (maternity centers) were excluded from the final sample as well. There were only 19 such cases. In order to focus on primary curative health care, the sample was further restricted to those individuals reporting an illness. Summary statistics of the data are reported in Table 1.

Since there is no private health care in rural Côte d'Ivoire, persons who wish to obtain medical care must choose between government clinics and outpatient wards of government hospitals. Of the 49 villages in the sample, 10 had clinics on the premise. There was no village with a hospital on premise, although in one case a hospital was as close as 6 minutes away. Thirty villages were served by hospitals further away than clinics. In 19 villages, hospital outpatient wards and clinics were equidistant. Maximum travel time (in one direction) was 5 hours for hospitals and only 2 hours for clinics. The travel time access cost is measured as the product of the value

of travel time to the nearest provider. The value of time is measured as the prevailing hourly wage rates in each cluster for adults males and females. Total household consumption is used as the household's total income measure.^{4/}

The arguments of the quality production function are the health status of the individual, human capital, and provider characteristics. As measures of health status we include age and the number of days the individual was healthy during the past four weeks. The number of healthy days is calculated as 28 minus the number of days the individual reported being restricted from normal activities due to illness over the last four weeks. Human capital is measured in years of schooling. The human capital variable is years of education, but educational attainment is typically low; approximately 84% of the sample reported no schooling.

The inputs to the agricultural production function are hectares of land and available labor measured by the number of prime age adults in the household. Another important productivity factor is the number of children. Children may reduce the adult time available for farm production. Age, sex and education are also likely to affect productivity.

V. Results

The coefficients and associated t-statistics from full information maximum likelihood estimation of the NMNL model are presented in table 3. Overall, the results are consistent with economic theory and common sense. The estimated value of σ is 0.46 and is significantly different from one at the 5% level, implying that the data reject MNL specification. Travel time both as an access cost and as a nuisance parameter, appears to be an important

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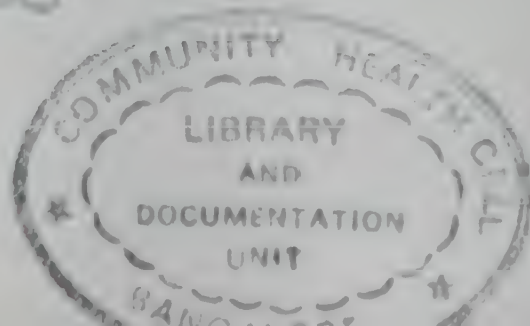


Table 1: Descriptive Statistics

Variable	Mean	Standard Deviation
Clinic <u>a/</u>	0.24	(0.42)
Hospital <u>a/</u>	0.15	(0.36)
Clinic travel time <u>b/</u>	0.58	(0.65)
Hospital travel time <u>b/</u>	0.93	(0.94)
Income <u>c/</u>	1.43	(1.27)
Hourly wage <u>d/</u>	65.56	(70.10)
Age	44.85	(17.12)
Male	0.46	(0.50)
Years of education	0.87	(2.21)
Healthy days	18.63	(9.93)
Number of adults	5.54	(4.64)
Number of children	5.29	(5.43)
Log (Land)	1.85	(0.84)
Sample Size	1030	

a/ Dummy variable, equal to one if alternative is chosen.

b/ Travel time is reported in hours.

c/ Income is reported in millions of CFA's. The exchange rate in 1985 was approximately 461 CFA's per U.S. dollar.

d/ Wage rate is reported in CFA's.

determinant of provider choice. The coefficient on time as an access cost is negative and significantly different from zero at the 5% level, and the coefficient on time as a nuisance parameter is negative and significant at the 10% level. More discussion about the magnitude of the travel time and income effects is presented in the next section.

The age effect is negative and significant (at the 1% level), and is substantially larger for hospitals than for clinics. There are two immediate explanations. The first is that medical care is less efficacious for older adults than it is for younger adults. For example, medical care has a greater impact on acute problems prevalent among the young than on chronic illnesses prevalent amongst the elderly. This is consistent with our empirical result that the demand for clinic care falls faster with age than the demand for hospital care. For chronic illnesses hospital care is likely to be more efficacious than clinic care. Another explanation follows from a motive to consume medical care as an investment in productivity. Grossman (1972) shows that the lower the marginal productivity of individuals, the smaller their investment in health. Elderly individuals are likely to be less productive in farm activities than prime age adults.

The effect of sex is not significantly different from zero in the clinic equation, and is positive and significant at the 1% level in the hospital equation. This result is consistent with males being more productive in farm activities than females.

The effect of education appears to be negligible. This most likely is a result of the small variation in education in the sample.

The farm input variables perform as expected. The number of adults in the household has a negative effect on the probability of going to both

clinics and hospitals. The greater the number of adults, the larger the labor force and the lower the marginal productivity of an individual. The lower the marginal productivity, the smaller the return to the investment in health. The coefficients on the number of children in the household are positive. The greater the number of children (who take up adult time), the higher the marginal productivity of an adult. Finally, the coefficient on hectares of land is positive and significant in the hospital equation, which is consistent with the notion that the greater the amount of land, the higher the marginal productivity of an individual.

VI. Time Price Elasticities and Income Effects

Since travel time and income enter the demand functions in a highly non-linear fashion, it is hard to assess the total magnitude of the travel time and income effects. To facilitate such analysis, we present arc travel time elasticities of the demand for clinic and hospital care by income quartiles in table 3. The arc elasticities are found by sample enumeration within each income quartile. Four half-hour travel time ranges are used for the arc elasticities calculations. The zero to two hour time range covers approximately 90% of the households. A vertical reading of table 3 reflects the change in the time price elasticity moving down the demand curve, holding income constant. A horizontal reading reflects the change in the time price elasticity as income rises, holding travel constant.

Two types of elasticities are considered in table 3. The first type is the total own time price elasticity, which, for example calculates the total percentage change in clinic demand with respect to a 1% change in clinic travel time. An increases in clinic travel time causes some individuals to

Table 2: Nested Multinomial Logit
Model of Provider Choice

	Coefficient	T-statistic
Access Cost $(\frac{wT}{Y})$ <u>a/</u>	-1.059	(2.18)
Nuisance parameter (T)	-0.289	(1.79)
Sigma	0.460	(2.69)
<u>Clinic Alternative</u>		
Constant	1.773	(1.70)
Age	-0.038	(2.01)
Sex	-0.042	(0.13)
Education	-0.077	(0.96)
Healthy days	-0.065	(1.91)
Adults	-0.122	(1.69)
Children	0.108	(1.65)
Log (land)	0.203	(0.79)
<u>Hospital Alternative</u>		
Constant	1.655	(1.53)
Age	-0.055	(2.92)
Sex	0.634	(1.74)
Education	0.093	(1.08)
Healthy days	-0.099	(2.82)
Adults	-0.122	(1.60)
Children	0.104	(1.59)
Log land	0.652	(2.54)
Log likelihood		-884.02
N		1030

a/ This variable was rescaled by multiplying it by 125 for estimation.

substitute hospital care for clinic care, and others to substitute self-care for clinic care. The second type of elasticity is the net elasticity, which examines the portion of demand that leaves the professional health care market. For example, it calculates the percentage of clinic demand that substitutes self-care for clinic care. The net elasticity has policy interest as it measures the number of individuals moving in and out of the professional health care market as a function of the distributional structure of health care supply.

We begin with a discussion of the own time price elasticities. Demand is substantially more elastic at higher travel times. Over the zero to two hour travel time range, the demand elasticities more than tripples. (Table 3). Specifically, the clinic demand elasticity for the lowest income quartile increases from -0.531 (for the 0 to 0.5 hour range) to -1.962 (for the 1.5 to 2.0 hour range). For the highest income quartile, the clinic demand elasticity increases from -0.230 to -0.854. Similar magnitudes are found for hospital demand.

The results also show that demand is vastly more elastic at the lower income levels. Specifically, the clinic demand elasticity for the lowest income quartile is more than double the elasticity for the highest income quartile. The clinic demand elasticities for the 0 to 0.5 hour interval range from -0.531 for the lowest income class to -0.230 for the highest income class. For the 1.5 to 2.0 hour interval, they range from -1.962 to -0.854. Again a similar pattern emerges for hospital care.

The net travel time elasticities, as expected, are lower than the own price elasticities, but not insignificant in magnitudes. This implies that significant numbers of individuals are forced out of the market due to travel

time rationing. In the lowest income quartile, the net clinic demand elasticity rises from -0.387 for the 0 to 0.5 hour interval to -1.039 for the 1.5 to 2 hour interval, and the net hospital demand elasticity rises from -0.361 to -0.807. In the highest income quartile, the net clinic demand elasticity rises from -0.102 to -0.326, and the net hospital elasticity rises from -0.87 to -0.266.

VII. Summary

This paper investigates the role of travel time as a health care rationing device in a developing country. Previous studies on the demand for health care demand in developing countries have typically found small travel time effects. These studies model the demand for health care as a discrete choice amongst providers with travel time entering the utility function as a nuisance parameter, and with the price effect specified to be independent of income. We derive a discrete choice specification from a theoretical model that has a natural interaction between price and income, and that includes travel time in the budget constraint as an access price, as well directly in the utility function as a nuisance parameter.

A Nested Multinomial Logit parameterization of the model was estimated using 1985 data from Côte d'Ivoire. Our findings indicate that indirect access costs such as travel time play an important role in rationing health care utilization. The results also show that health care demand amongst poorer individuals is substantially more travel time elastic than amongst the rich.

Table 3: Arc and Net Travel Time Elasticities

Travel Time-Range (hours)	Quartile 1 (lowest)		Quartile 2 (lowest)		Quartile 3 (lowest)		Quartile 4 (highest)	
	Own	Net	Own	Net	Own	Net	Own	Net
<u>Clinics</u>								
0 - 0.5 hour	-0.531	-0.387	-0.339	-0.203	-0.293	-0.148	-0.230	-0.100
0.5 - 1.0 hour	-0.991	-0.638	-0.646	-0.355	-0.545	-0.256	-0.415	-0.174
1.0 - 1.5 hours	-1.486	-0.861	-1.003	-0.510	-0.835	-0.367	-0.625	-0.250
1.5 - 2.0 hours	-1.962	-1.039	-1.392	-0.660	-1.150	-0.479	-0.854	-0.320
<u>Hospitals</u>								
0 - 0.5	-0.696	-0.361	-0.439	-0.194	-0.341	-0.136	-0.226	-0.080
0.5 - 1.0	-1.242	-0.557	-0.812	-0.330	-0.618	-0.231	-0.403	-0.140
1.0 - 1.5	-1.722	-0.691	-1.222	-0.465	-0.924	-0.326	-0.598	-0.200
1.5 - 2.0	-2.128	-0.807	-1.648	-0.593	-1.250	-0.422	-0.807	-0.260

NOTES

- 1/ See Ainsworth (1983), de Ferranti (1985) and Jimenez (1986) for a discussion on health care pricing methods in developing countries.
- 2/ Studies of the demand for health care in developing countries include Akin et.al. (1981, 1985 and, 1986), Birdsall and Chuhan (1983) and (1986), Dor and van der Gaag (1987), Gertler, Local, and Sanderson (1986), Heller (1983), Musgrove (1983), and Mwabu (1986).
- 3/ For detailed information on this survey, see Grootaert (1985), and Ainsworth and Muñoz (1985).
- 4/ For a description on how total household consumption was calculated see Glewwe (1986).

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